REMARKS/ARGUMENTS

Overview

This paper is being filed to respond to the Examiner's demands in the Office Action mailed April 29, 2005, and the Examiner's subsequent Notice mailed January 4, 2006.

Provisional Double Patenting Rejection

Claims 1 to 8 are provisionally rejected over claims 1, 2, 4 5, 7, 8, and 6 respectively in copending application 10/618,524. The Applicant respectfully traverses this provisional rejection.

As stated in the Summary of the Invention, the invention includes head gimbal assemblies, which include mechanisms for moving the slider parallel the disk surface, when it is flat, and radially moving the slider toward the track, when the disk surface is bent. The invention includes three sets of these mechanisms. The Claims of the '524 application points to the third inventive mechanism, whereas this application claims embodiments based upon the first mechanism which may further use the third mechanism. While the Applicant does not agree with this provisional rejection, the Applicant is willing to file a terminal disclaimer.

As found in the initially filed application, "*A third set of mechanisms move the actuator arm by lever action through the principal axis. The actuator holds the slider parallel to the disk surface, when it is flat. The slider is mounted by a flexure at a second bias angle to the principal axis. The flexure responds as the disk surface bends through the second bias angle, causing the slider to move radially toward the track.*" (page 4, lines 12-16).

Two paragraphs of the specification starting on lines 5 and 11 on page 12 have been amended to more clearly call this out:

> *Figures 7B to 8D show examples of a third inventive mechanisms for reducing TMR. This includes moving the actuator arm by the lever action through the principal axis when the slider is parallel to the disk surface. The slider is mounted on a flexure at a second bias angle ~~710~~ 712 to the principal axis. The means for radially moving the slider includes the flexure responding as the disk surface bends through the second bias angle, causing the slider to move radially toward the track.*

> *Figure 7B shows a top view of the suspension attached to base plate 70, with two points 722 and 724 welding flexure 90 to load beam 80, providing second bias angle ~~710~~ 712. Flexure 90 attaches to both slider 100 and to load beam 80. The number of welding points close to the slider is preferably at least two. If the line between welding points is not perpendicular to the principal axis 110, then the trajectory of bending motion of the flexure induced by disk axial vibration will be on a tilted bending line. It is sometimes preferred that the line, between the welding points 722 and 724, is not perpendicular to the principal axis 110.*

This is further shown in Figures 7B to 11B. Figures 7B to 8D, 9B, 9D, 9F, 10B, 10D, and 10F have been amended by replacing reference number 710 with reference number 712 to correspond to the above amended paragraphs.

The Applicant submits that with these amendments and expanded discussion, the third mechanisms are now clearly pointed out. The Applicant still does not agree with the provisional double patenting rejection. The Examiner is requested to remove the provisional double patenting rejection. Should the Examiner still find in his opinion a basis for the provisional double patenting rejection, the Applicant is still willing to file a terminal disclaimer.

Rejections under 35 USC 112 second paragraph

Claims 1 to 19 stand rejected as indefinite. The Examiner contends that "there is no definition in the specification for the list 'means for moving said slider' (claims 1 and 43) and 'means for radially moving' (claims 1 and 43)".

Disclosure required under 37 CFR 105 for Claim 1

Regarding Claim 1:

1. (original) A mechanism moving a slider toward a track on a disk surface in a hard disk drive, to minimize track mis-registration, comprising:

means for moving said slider parallel to said disk surface toward said track, when said disk surface is flat, by an actuator arm moving said slider by a lever action through a principal axis with said slider aligned at a bias angle;

wherein a read-write head is encapsulated in said slider facing said rotating disk surface about a radial center in a hard disk drive;

wherein said read-write head is communicatively coupled with said rotating disk surface to communicatively access said track; and

means for radially moving said slider toward said track when said disk surface is bent, by said lever action through said principal axis at said bias angle causing said slider to move radially toward said track, when said disk surface is bent.

The Applicant found that the Figures 3A to 3D refer specifically to the first inventive mechanisms, which was described in the Summary as "*In a first set of mechanisms, the actuator arm moves by lever action through a principal axis, with the slider aligned at a bias angle and the slider face parallel to the flat disk surface. The*

lever action causes the slider to move radially toward the track, when the disk surface is bent." (page 4 lines 4 to 7). This is specifically described in the Brief Description of the Drawings in lines 9 to 15 on page 5 and lines 20 to 23 on page 6:

"Figure 3A is a cross section view through a disk of a first inventive mechanism operating when the disk surface bends down;

Figure 3B is a radial-directional view through the disk of the first inventive mechanism, when the disk surface bends down;

Figure 3C is a cross section view through the disk of the first inventive mechanism operating when the disk surface bends up;

Figure 3D is a radial-directional view through the disk of the first inventive mechanism operating when the disk surface bends up;

Figure 14C is the geometric analysis used for the roll bias angle formula for the roll center mechanisms of FIGS. 4A to 7A when the disk surface bends down as in Figure 8A;

Figure 14D is the geometric analysis used for the roll bias angle formula for the roll center mechanisms of Figures 4A to 7A when the disk surface bends up as in Figure 9A;"

All of these Figures relate specifically to the first set of inventive mechanisms using the bias angle, which is also referred to as the roll bias angle and variously denoted as 710 and φ in the Figures and as φ in the formulas, in that the second set of inventive mechanisms does not involve the bias angle.

The actuator arm 50 moves by lever action through a principal axis 110, with the slider 100 aligned at the bias angle (710 or φ) and slider face parallel to the flat disk

surface 12, as shown in Figures 4A to 6A and 7A. The lever action causes the slider to move radially toward the track 18, when the disk surface is bent, as shown in Figures 3A to 3D, 14C and 14D. The two means are the same mechanism responding to the disk surface through the bias angle in two distinctive conditions, when the disk surface is flat and when it is bent up or down.

One example of the "*means for moving said slider parallel to said disk surface toward said track, when said disk surface is flat, by an actuator arm moving said slider by a lever action through a principal axis with said slider aligned at a bias angle*" can thus be seen in Figure 4A. Here, the means for moving the slider parallel includes a head gimbal assembly 60 including a suspension having bias angle 710, attached by connection beam 82 to extended base plate 84, where the suspension mounts on the actuator arm 50, at bent edge 700 of extended base plate 84 and at bent edge 702 of load beam 80.

Regarding the "*means for radially moving said slider toward said track when said disk surface is bent, by said lever action through said principal axis at said bias angle causing said slider to move radially toward said track, when said disk surface is bent*", this is seen in Figures 3A to 3D, 14C and 14D, where the slider 100 moves radially toward the track through the mechanism discussed for moving parallel the flat disk surface, but now the disk surface is bent, and the mechanism discussed regarding these Figures operates through the lever action through the principal axis at the bias angle, causing the slider to move radially toward the track.

A second example of the "*means for moving said slider parallel to said disk surface toward said track, when said disk surface is flat, by an actuator arm moving said slider by a lever action through a principal axis with said slider aligned at a bias angle*" can be seen in Figure 4B. Here, the head gimbal assembly 60 includes a suspension having bias angle 710, attached to base plate 70, where it mounts on the actuator arm 50, at bent edge 704 of base plate 70 and at bent edge 700 of load beam 80.

Again, the "*means for radially moving said slider toward said track when said disk surface is bent*", this is seen in Figures 3A to 3D, 14C and 14D, where the slider 100 moves radially toward the track through the mechanism discussed for moving parallel the flat disk surface, but now the disk surface is bent, and the mechanism discussed regarding these Figures operates through the lever action through the principal axis at the bias angle, causing the slider to move radially toward the track.

A third example of the "*means for moving said slider parallel to said disk surface toward said track, when said disk surface is flat, by an actuator arm moving said slider by a lever action through a principal axis with said slider aligned at a bias angle*" can be seen in Figure 4C. Here, the head gimbal assembly 60 includes a suspension having the bias angle 710, attached by connection beam 82 to extended base plate 84, which is mounted on the actuator arm 50, at the bent edge 700 of the extended base plate 84.

Again, the "*means for radially moving said slider toward said track when said disk surface is bent*", this is seen in Figures 3A to 3D, 14C and 14D, where the slider 100 moves radially toward the track through the mechanism discussed for moving parallel the flat disk surface, but now the disk surface is bent, and the mechanism discussed regarding these Figures operates through the lever action through the principal axis at the bias angle, causing the slider to move radially toward the track.

A fourth example of the "*means for moving said slider parallel to said disk surface toward said track, when said disk surface is flat, by an actuator arm moving said slider by a lever action through a principal axis with said slider aligned at a bias angle*" can be seen in Figure 4D. Here, the head gimbal assembly 60 includes a suspension having bias angle 710, attached to base plate 70, which is mounted on the actuator arm 50, at bent edge 704 of base plate 70.

Again, the "*means for radially moving said slider toward said track when said disk surface is bent*", this is seen in Figures 3A to 3D, 14C and 14D, where the slider 100 moves radially toward the track through the mechanism discussed for moving parallel the

flat disk surface, but now the disk surface is bent, and the mechanism discussed regarding these Figures operates through the lever action through the principal axis at the bias angle, causing the slider to move radially toward the track.

Regarding Claim 2:

> *2. (previously presented) The mechanism of Claim 1, wherein the means for moving said slider parallel said disk surface arm further comprises means for said actuator arm moving, through a flexure, said slider mounted to said flexure at a second bias angle to said principal axis;*
>
> *wherein the means for radially moving said slider further comprising:*
>
> *said flexure responding as said disk surface is bent, through said second bias angle, causing said slider to move radially toward said track.*

As stated in the Summary of the Invention, page 4 lines 12 to 17: "*A third set of mechanisms move the actuator arm by lever action through the principal axis. The actuator holds the slider parallel to the disk surface, when it is flat. The slider is mounted by a flexure at a second bias angle to the principal axis. The flexure responds as the disk surface bends through the second bias angle, causing the slider to move radially toward the track. The present invention provides head gimbal assemblies incorporating mechanisms of the first set operating with mechanisms of the third set.*" Figures 7B to 8D and 11A to 11D show example mechanisms employing this third approach, which may be used with the first set of mechanisms as already discussed.

The means for moving the slider 100 parallel to the disk surface 12 further includes the flexure 90 at a second bias angle 712. The means for radially moving the slider further includes the flexure responding as the disk surface bends through the second bias angle, further causing the slider to move radially toward the track 18, as discussed in the amended paragraph on page 12 lines 5 to 10.

3. (original) The mechanism of Claim 2, wherein said flexure is mounted to said actuator arm at said second bias angle.

Figure 7B shows an example of this Claim, as well as Claims 4 and 5, where the flexure 90 is mounted to the actuator arm at the second bias angle 712.

4. (original) The mechanism of Claim 3, wherein at least two welds mount said flexure to said actuator arm at said second bias angle.

5. (original) The mechanism of Claim 4, wherein at least two welds mount said flexure to a load beam coupled to said actuator arm at said second bias angle.

Claim 6 is enabled by the amended Figures 8A to 8D, which show examples of the slider 100 mounted to the flexure 90 at the second bias angle 712, as discussed by the amended paragraphs of the specification. The means for moving the slider parallel the disk surface when it is flat is shown by these Figures and discussed as above. The means for radially moving includes the flexure responding as the disk 12 is bent through the slider being mounted at the second bias angle, causing the slider to move radially toward the track 18, as shown in Figures 11A to 11D.

6. (original) The mechanism of Claim 2, wherein said slider is mounted to said flexure at said second bias angle.

The discussion of the roll bias angle found in the amended paragraph replacing the paragraph starting on line 7 of page 14 enables both Claim 7 and 8. The amended paragraph:

The bias angle 710 <u>and the second bias angle 712</u> of the earlier Figures is the roll bias angle φ of Figures 14A-16C. In Figure 14A, the roll bias

*angle φ = arc cos((a - b cos θ) / c) for the disk bending down. In Figure 14B, the roll bias angle φ = arc cos((b cos θ - d) / c) for the disk bending up. This leads to $\varphi \approx 1.2$ degrees of arc at the Outside position of Disk OD, with r = 45 mm. In Figures 14A and 14B, the radial motion of slider 100 is about h = b * sin θ = (ts+td/2) sin θ.*

Claims 7 and 8:

7. (original) The mechanism of Claim 2, wherein said second bias angle is between one-half degree and three degrees.

8. (original) The mechanism of Claim 7, wherein said second bias angle is between three-quarters degree and five-halves degrees.

Summary of the Response

This Office Action has required a very unusual response to a very mechanically complex invention. It has been deemed best to focus prosecution on claim 1-8 and to pursue the canceled and withdrawn claims in later. The Applicant's response has addressed all of the issues raised by the Examiner. Accordingly, the Applicant respectfully requests allowance of the application.

Request for Telephone Interview if the Application is not in condition for allowance

The Applicant believes that this response places the pending Claims in condition for allowance. The Applicant requests a telephone interview if the Examiner finds otherwise.

Very respectfully submitted,

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Annotated Sheet for 10/619,163

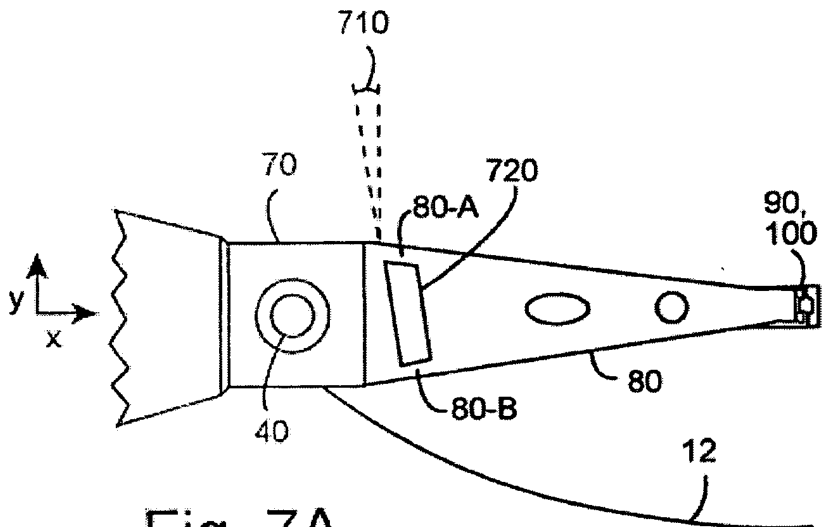

Fig. 7A

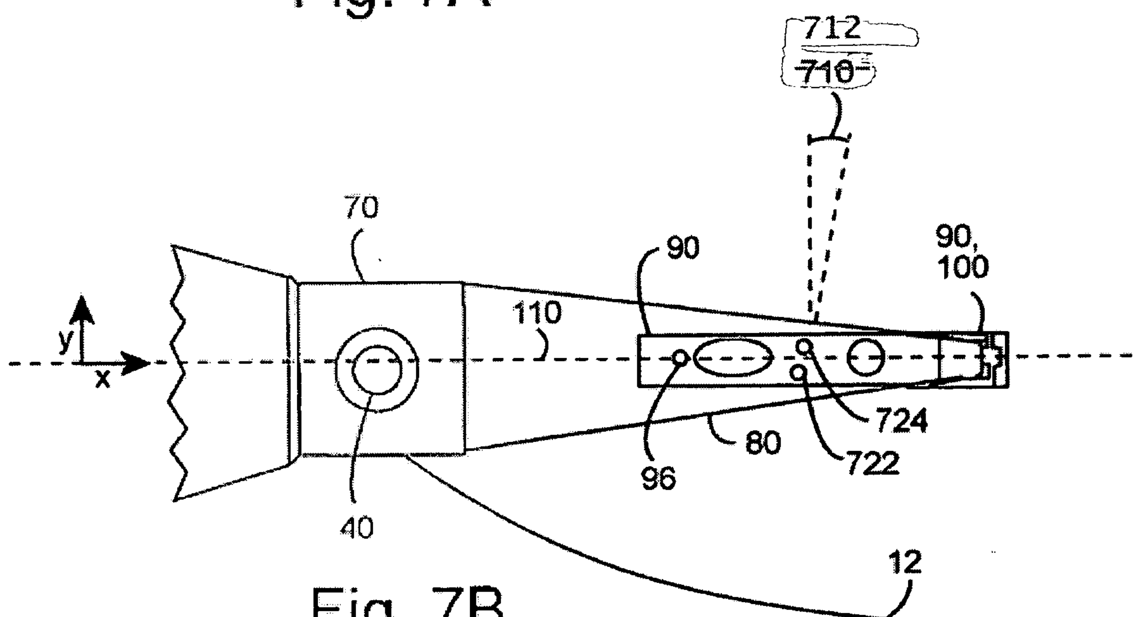

Fig. 7B

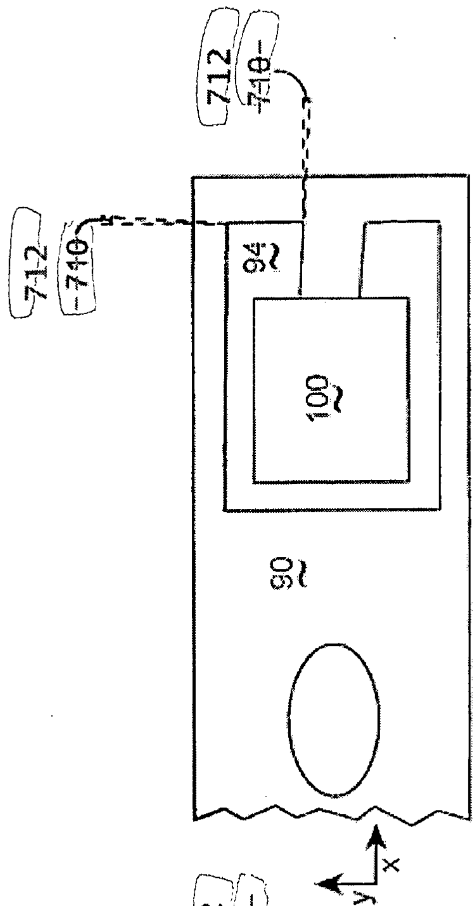

Fig. 8B

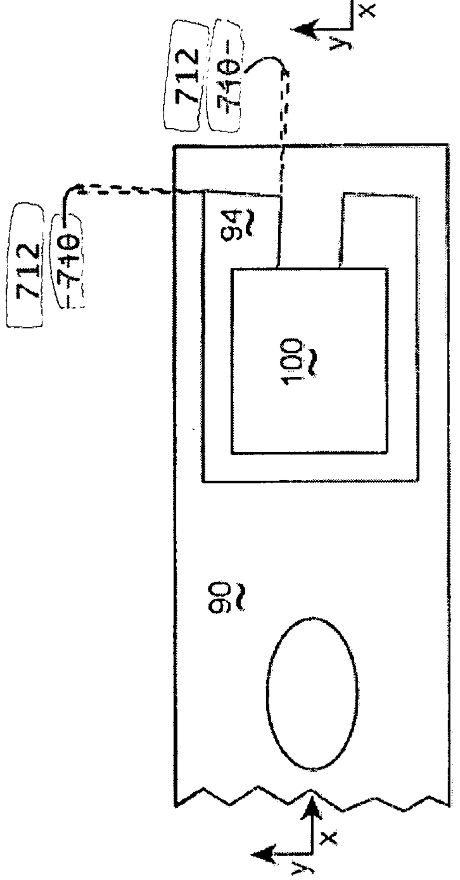

Fig. 8A

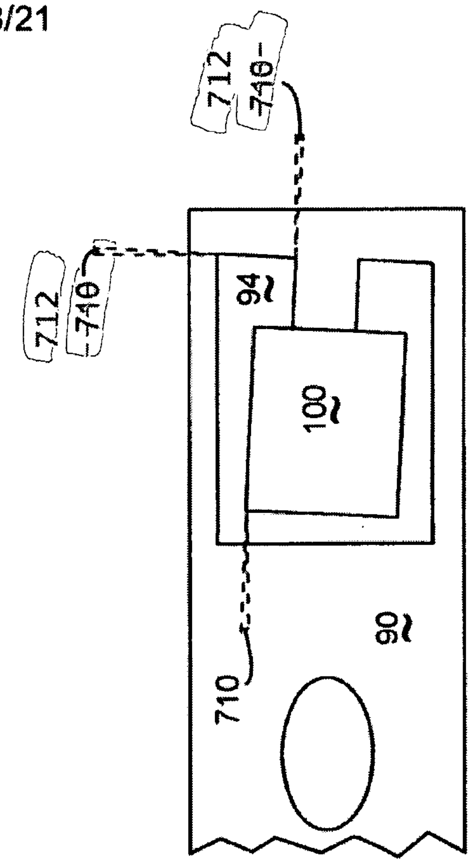

Fig. 8D

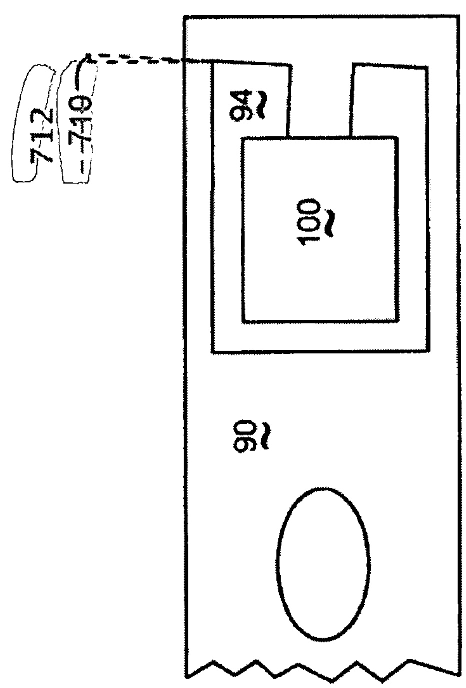

Fig. 8C

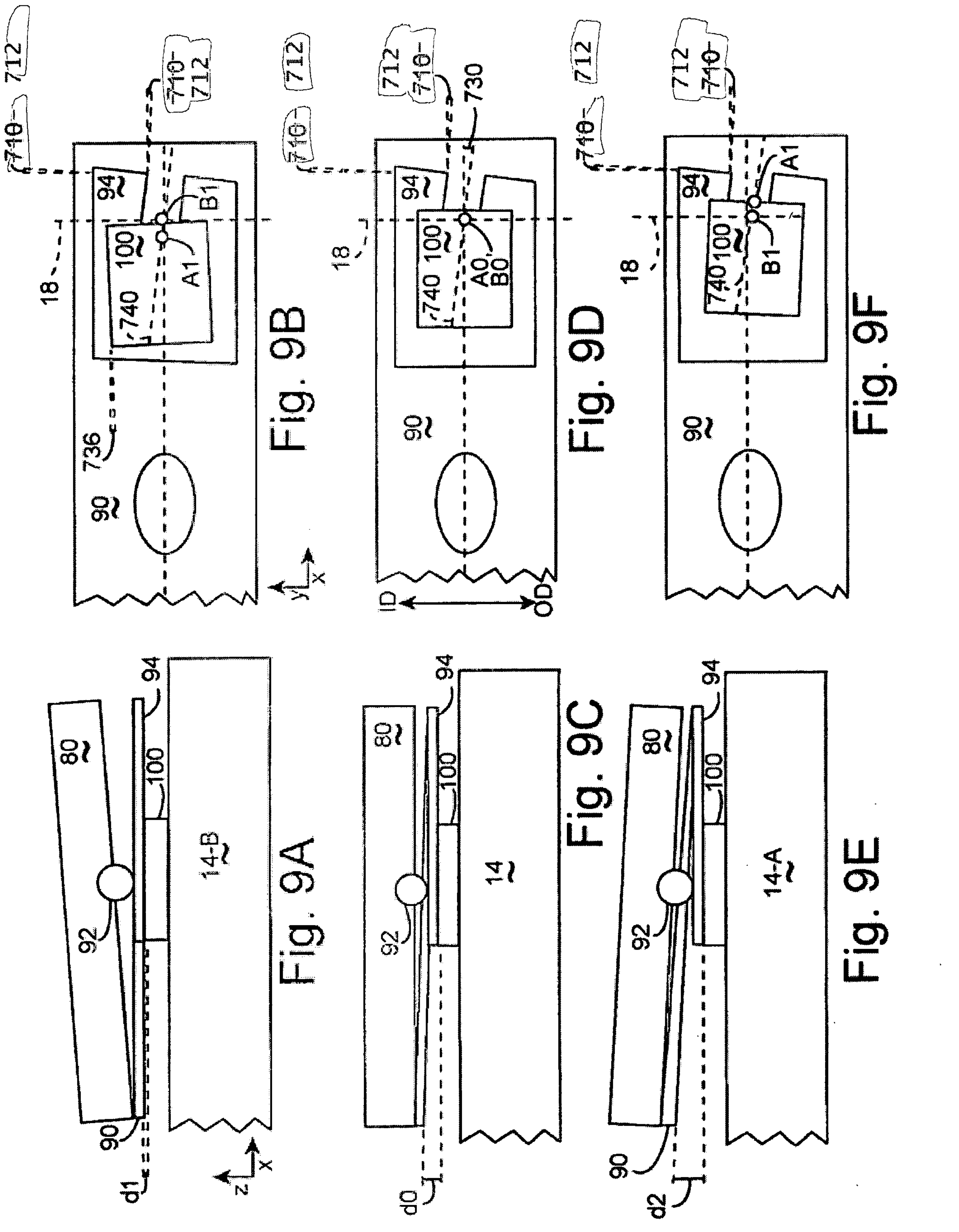

Fig. 9A Fig. 9B Fig. 9C Fig. 9D Fig. 9E Fig. 9F

Annotated Sheet for 10/619,163

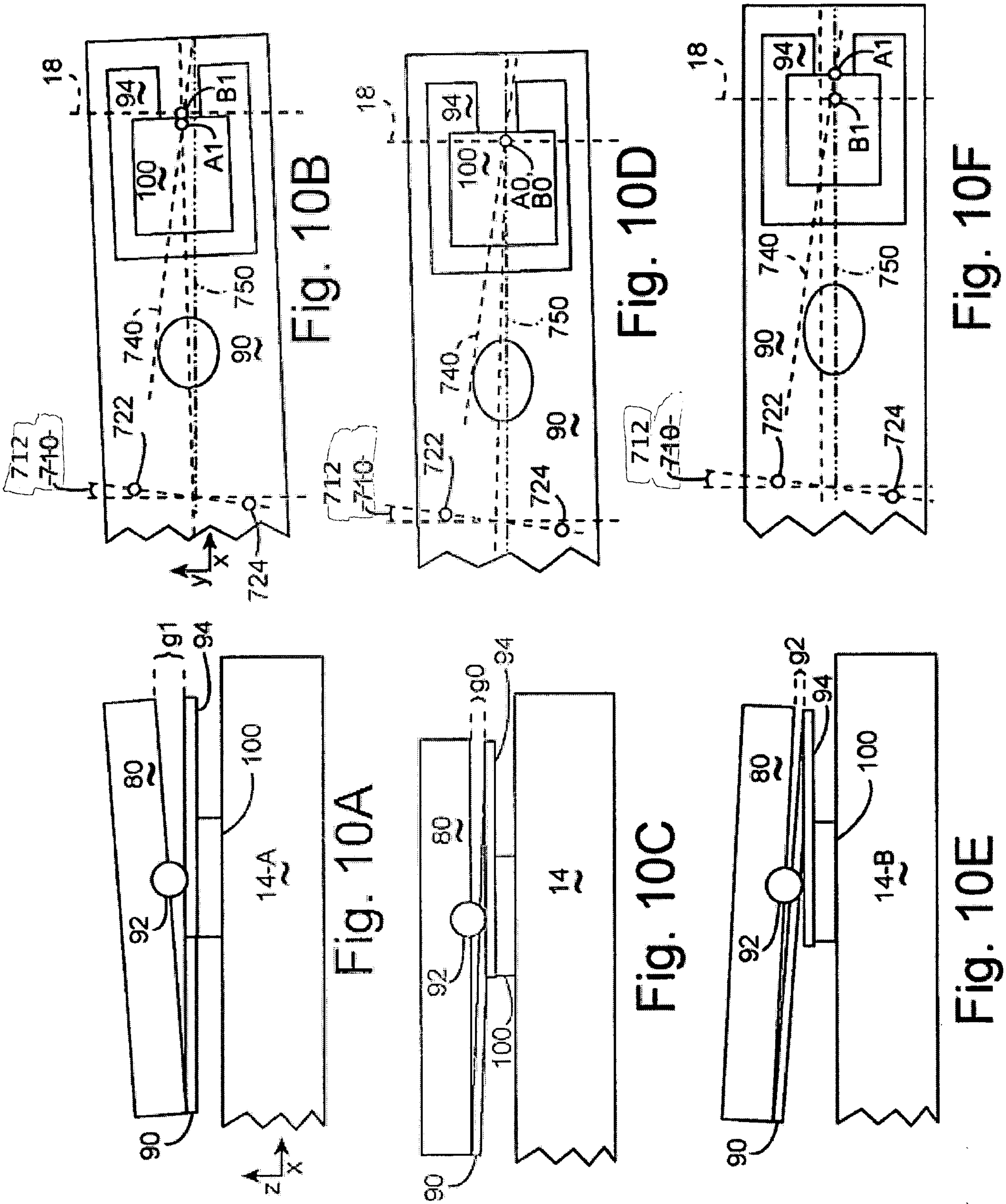

Fig. 10B

Fig. 10D

Fig. 10F

Fig. 10A

Fig. 10C

Fig. 10E